NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

(Acre)
CODE 657

DEFINITION

A rehabilitation of a drained or degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural condition to the extent practicable. This applies only to class a (low hazard) structures with a fill height of ten feet or less.

PURPOSE

To restore hydric soil conditions, hydrologic conditions, hydrophytic plant communities, and wetland functions that occurred on the disturbed wetland site prior to modification to the extent practicable.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to sites with hydric soil which were natural wetlands that have been previously degraded hydrologically and/or vegetatively.

This practice is applicable only if natural hydrologic conditions can be restored by modifying drainage and/or artificial flooding of a duration and frequency similar to natural conditions. Pumping is not an acceptable method of approximating natural hydrologic conditions.

If the presence of hazardous waste materials in the sediment or fill is suspected, soil samples will be collected and analyzed for the presence of hazardous waste as defined by local, state, or federal authorities. Sites containing hazardous waste will not be restored under this standard.

Criteria in this section shall be followed except that dikes with an effective height greater than 10 feet shall be designed using the criteria for Pond (378) or Grade Stabilization Structure (410).

This practice does not apply to:

1. Constructed Wetland (656) intended to treat point and non-point sources of water pollution;
2. Wetland Enhancement (659) intended to enhance specific functions and/or values beyond original wetland conditions; or
3. Wetland Creation (658) for creating a wetland on a site location which historically was not a wetland or was formerly a wetland but will be replaced with a wetland type not naturally occurring on the site.

CRITERIA

General Criteria. The landowner shall obtain necessary local, state, and federal permits that apply before restoration.

Upon completion of the restoration the site will meet the current NRCS soil, hydrology, and vegetation criteria for a wetland.

Acquisition of land use rights, including flowage easements, are assured prior to practice application if required.

Establish vegetative buffers on surrounding uplands around the wetlands to reduce the movement of sediment and soluble and sediment-attached substances carried by runoff. Use practice standard Upland Wildlife Habitat Management (645) or Restoration and Management of Declining Habitats (643) to design the vegetative buffer.

Criteria for Hydric Soil Conditions. Restoration sites will be located on hydric soils.

Reestablish an approximation of the original soil microtopography.

Criteria for Hydrology Restoration. A permanent water supply should be available approximating the needs of the wetland.

Wetland hydrology should be restored as much as possible to its original condition before it was manipulated. As a minimum, the hydrologic soil condition must be able to support hydrophytic vegetation. The maximum hydrology and the overall hydraulic variability of the restored site will approximate the conditions that existed before alteration, e.g., dynamic and static water levels, soil saturation.

Existing drainage systems will be utilized, removed or modified as needed to achieve the intended purpose.

Criteria for Vegetation. The vegetation shall be restored as closely to the original natural plant community as the restored site conditions will allow.

Determination of the original plant community's species and percent composition shall be based upon reference wetlands of the type being restored or a suitable technical reference.

Plantings, seeding, or other types of vegetative establishment will be comprised of native species that occur on the wetland type being restored.

In soils where seedbanks of desirable species realistically exist or natural succession of selected native species (identified from reference wetlands) will dominate in less than five years, natural regeneration will be allowed for revegetation of the wetland. The topsoil from wetland excavated areas will be stockpiled and redistributed to maintain plant seedbanks.

In wetlands where supplemental vegetation is necessary, plantings will be done. Applicable guidelines can be found in Tree/Shrub Establishment (612); Woodland Direct Seeding (652); Wildlife Wetland Habitat Management (644); and Engineering Field Handbook (EFH), Chapter 13, Wetland Restoration, Enhancement, or Creation.

Plantings, seeding, or other types of vegetative establishment will be comprised of native species that occur on the wetland type being restored. Preference shall be given to plant materials collected within a 200-mile radius from the site.

Adequate substrate material necessary for proper establishment of the selected plant species shall be included in the design.

If uplands are planned as part of a restoration, then native seedings should be used for these areas as well. Refer to Upland Wildlife Habitat Management (645) or Restoration and Management of Declining Habitats (643) for herbaceous restorations. Refer to Tree/Shrub Establishment (612), Woodland Direct Seeding (652) and Upland Wildlife Habitat Management (645) if trees and/or shrubs are desired.

On sites which were predominantly herbaceous vegetation prior to modification, and planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the number of ecological sites present. Sites restored to only one ecological site shall be established with at least two species adapted to the site. Sites with two or more ecological sites (i.e., wet meadow, shallow marsh, or deep marsh etc.) shall be established with at least one native species on each ecological site.

Herbaceous vegetation may be established by a variety of methods including: mechanical or aerial seeding, topsoiling, organic mat placement, wetland sod, vegetative sprigs, wetland hay, etc., over the entire site or a portion of the site and at densities and depths appropriate.

Forested wetland plantings and/or seeding will include a minimum of three tree or shrub species on each ecological site (i.e., scrub/shrub, bottomland hardwood, etc.), where appropriate. Tree (and shrub) planting will follow the criteria of practice standard Tree/Shrub Establishment (612).

Seed planting rates and site preparation will meet the criteria of practice standard Woodland Direct Seeding (652). Seed viability will be determined prior to planting.

Areas disturbed by construction shall be revegetated using critical area stabilization.

Criteria for Wetland Functions. It is recommended that a functional assessment be performed on the site prior to practice application using the appropriate method.

Restoration goals and objectives shall include targeted natural wetland functions for the wetland type and the site location as determined by the functional assessment and reference site data. A post-project assessment will be performed after an adequate period to assess the success of the practice restoration.

DESIGN CRITERIA

Hydrology & Hydraulics. The site shall be designed to handle the 10 year-24 hour precipitation event by a combination of storage and spillway(s) capacity. Tables 2A through 2C are provided for quick and conservative design of this practice. A flood routing may be completed and the results used in place of Tables 2A through 2C. Sites exceeding the criteria in the tables must use flood routing.

The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow as shown in Tables 2A through 2C or as determined by flood routing, less any reduction creditable to conduit discharge and detention storage. Tables 2A through 2C assume an emergency spillway in good condition. A good spillway is one which will support vegetation (or is otherwise protected) and has exit slopes which lie within the ranges as defined in the EFH, Chapter 11, Exhibit 11-2, Table 3. A poor emergency spillway is one that will likely sustain damage from an appreciable flow but will protect the principal spillway structure and embankment during the passage of a single design storm. Structures with a poor emergency spillway must increase the principal spillway design storm to a 25-year, 24-hour precipitation event

The design storm must be safely controlled by the reservoir with a combination of storage and spillway capacity. When flood routing is done, the routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days drawdown from the 10 year, 24 hour design storm, whichever is higher. The 10-day drawdown shall be computed from the crest of the emergency spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Emergency spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Subsurface Drainage Alteration. In areas where subsurface drains are used to alter hydrology of the site, the existing drainage system shall be modified to the extent possible to restore the hydrologic conditions of the wetland. Review of drainage records, interviews, and site investigations may be needed to determine the extent of the existing drainage system.

In some cases, existing subsurface drains may be blocked or controlled to restore wetland conditions to previously drained lands. Blocks and control structures shall be adequate to meet all hydraulic, structural, and other functional requirements.

Where the drain lines serve as outlets from other areas where drainage is still desired, appropriate measures shall be included in the design to keep the upstream drainage system(s) maintained at its current capacity.

The effects of the subsurface drainage system may be modified or eliminated by one or a combination of the following:

1. removing or rendering inoperable a portion of the drain at the downstream edge of the site,
2. modifying the drain with a water control device,
3. outletting the drain above the wetland area,
4. routing the drain around, away from, or through the wetland area.

When removing a portion of the drain downstream of the site, the length removed shall be sufficient so that the drain does not alter the hydrology of the wetland. Use lateral effect information to determine the break location.

The minimum length of drain that should be removed or rendered inoperable at each tile break is 100 feet.

Where dikes or embankments are to be constructed over existing drains, the entire length of the drain under the earthfill shall be removed. In addition, a minimum length of 25 feet of tile shall be removed upstream from the upstream toe of the earthfill, and 50 feet shall be removed downstream of the downstream toe of the earthfill.

All envelope, filter material or flow enhancing material shall be removed within the length specified for tile removal. This includes tile fragments and debris. Where tile is removed, each exposed end of the remaining tile shall be plugged or capped to prevent water from entering or exiting the tile. The trench from tile removal shall be filled with similar soil and compacted to achieve the density equivalent to adjacent existing material.

If the drain is routed around the wetland and perforated drain tubing or sectioned tile is used, the drain shall be located so that it has no hydrologic effect on the wetland area. This minimum offset distance from the wetland should be determined by scope and effect equations; see EFH, Chapter 19, Hydrology Tools for Wetland Determination.

In general, routing non-perforated drainage tile through a wetland should be avoided. If it is necessary, the design shall consider flotation of the tile.

Embankment Structures and Dikes.
Foundation**.** A core trench is required if the fill height is greater than seven feet. A core trench should be considered under a dike to insure dike stability and to prevent excess seepage losses. This may include the entire dike length, short sections located in old drainageways, or areas near a water control structure. The core trench shall have a bottom width adequate for the necessary excavation, backfill, and compaction, but not less than 4 feet. Side slopes shall not be steeper than 1:1.

The centerline of the cutoff shall be located at or upstream from the centerline of the dam. Core trenches will be excavated to a minimum depth of 2 feet below the existing ground level.

Earthfill. Dikes shall have constructed side slopes of 3:1 upstream and 2:1 downstream or flatter. Flatter upstream side slopes shall be considered when potential exists for excessive wave action, ice action, erosion in organic soils on the face, or rodent action.

The embankment or dike may be homogeneous or have an impervious core. The minimum top width shall be 8 feet. The use of organic soils and sandy soils is not allowed without a variance approved by the state conservation engineer.

The height of the embankment needs to include sufficient allowances for the volume of storage required, the routing of the design storm(s), additional height for wave action, freeboard required, and a settlement allowance.

The design height of the dike shall be increased by a minimum 5 percent to allow for settlement.

The difference in elevation between the crest of the vegetated spillway and the top of the settled dike shall be the sum of the flow depth of the design storm through the vegetated spillway and at least the minimum freeboard allowance of 0.5 ft. The column labeled HP in Tables 2A through 2C provides information on the flow depth of the freeboard storm through the vegetated spillway.

When the water depth exceeds two feet against the embankment, the difference in elevation between the permanent pool elevation and the top of the settled dike shall be a minimum of 1.5 feet.

Flow over Top. In special situations, it may be desirable to design an embankment with spillway flow over the top of the embankment. The use of this type of design is limited to shallow earthfill within a drainage ditch. All of the following conditions must be met for a flow-over embankment within a ditch (also called a ditch plug) to be allowed:

1. Damage likely to occur from the failure of the embankment is minimal.
2. Drainage area < 50 acres,
3. A trickle tube or principal spillway is optional by the design tables in this standard.
4. Fill height < 5 feet,
5. No baseflow is present,
6. Stable grade downstream, and
7. A good stand of vegetation can be established on the earthfill.

In these cases, use a minimum top width of 50 feet, 3:1 upstream slopes, and 20:1 or flatter downstream slopes. An upstream slope of 6:1 or flatter is preferable.

Borrow Area. If a borrow area is located upstream or downstream from an embankment, it will be located so that the minimum distance between the toe of the embankment and the edge of an excavated borrow area will be at least fifty (50) feet.

Wave Action. The design of all earthen embankments shall consider the impacts of wave action. Appropriate measures to protect against wave damage may include:

1. A flatter upstream embankment slope;
2. A berm with a minimum 10 foot radius may be provided around a 24” diameter or larger water control structure to minimize vegetative plugging;
3. Riprap or other erosion control material;
4. Additional fill height.

Vegetation. A seeding plan shall be prepared according to the criteria in Standard 342, “Critical Area Planting.”

Principal Spillway.

The minimum pipe diameter shall not be less than 6 inches. If the pipe conduit diameter is 10 inches or greater, or 8 inches with an effective trash rack, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway in a flood routing. The pipe may not be considered in the flood routing unless it has a free outlet. In no case shall the difference in elevation between the principal and vegetated spillway be less than 0.5 foot.

If base flow, which may include seepage, subsurface drainage or spring flow exists, a trickle tube or water control structure shall be provided.

Pipe conduits under or through the dam shall meet the following requirements.

(1) Flexible pipe strength shall not be less than that necessary to support the design load with a maximum of 5 percent deflection.
(2) The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe.

Acceptable pipe materials for fills less than ten feet in height are:

- PVC 1120 or 1220, conforming to ASTM D 1785 or ASTM D2241 – Standard Dimension Ratio (SDR) 26 or Schedule 40
- Corrugated steel pipe - minimum gage 16
- Corrugated aluminum – minimum thickness 0.06 inch up to 24” diameter, and 0.075inch for 30” and 36” pipe
- Reinforced concrete pipe
- High density plastic dual wall

Other pipe material may be used if not under the fill.

<u>Seepage control.</u> Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The conduit is of smooth pipe larger than 8 inches in diameter and the pool depth is 3 feet or greater against the embankment.
2. The conduit is of corrugated pipe larger than 12 inches in diameter.

Seepage control is required on all structures with a permanent pool adjacent to the upstream slope of the fill that is more than 2 feet deep and exists for more than two days. Seepage control may not be needed where the water control structure outlets into a downstream tile line. Table 1 indicates required seepage control.

Table 1. Mandatory seepage control

Depth of water against fill, feet	Minimum Seepage Control Required
0-2 feet	None
2-5 feet	one anti seep collar
Greater than 5 feet	Follow criteria in 378, Pond standard

Seepage along pipes extending through the embankment shall be controlled by use of a filter and drainage diaphragm, unless it is determined that antiseep collars will adequately serve the purpose.

Vegetated Spillway.
The vegetated spillway shall be designed to safely control the flow from the storm as indicated in Tables 2A through 2C or as determined by the flood routing procedure. Use of vegetated spillways in natural low areas without shaping is desirable since established vegetation is not disturbed. A natural or excavated spillway shall have a minimum 10 foot bottom width.

A vegetated spillway must be provided for each embankment, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an emergency spillway: (1) a conduit with a cross-sectional area of 3 ft^2 or more, (2) an inlet that will not clog, and (3) an elbow designed to facilitate the passage of trash.

Spillways shall have a minimum length of level section upstream from the control section of 30 feet. The centerline of the approach channel upstream of the level section shall be tangent to the centerline of the level section. The shape of the level section shall have the same dimensions (side slope and bottom width) as the outlet section.

The designer shall be responsible for determining that the flow through a vegetated spillway is designed to be stable in as-built and aged conditions.

Where the outlet has or will have seepage problems, appropriate measures shall be installed to maintain a stable outlet and promote good sod producing vegetation.

The vegetated spillway shall be located in a position that minimizes the likelihood for flood flows from the stream system to damage the dike and water control structure and vegetated spillway. Refer to EFH, Chapter 11, Ponds and Reservoirs, for design procedures.

Floodplain Wetland Dikes. For dikes located in a floodplain, overtopping of the dike by flow from the floodway into the wetland is likely. In addition to the criteria already given, vegetative spillways associated with dikes located in a floodplain may be located on level natural ground, in excavation, or on compacted fill. Vegetated spillways shall be at least 100 feet wide and have a crest length of at least 30 feet.

Dikes constructed in a floodplain with a principal spillway shall have an additional 1-foot of overfill added to the constructed height to protect the control structure from damage by the overflow water. This additional height shall be constructed for a distance of 50 feet on each side of the principal spillway or water control structure.

CONSIDERATIONS

The objectives of a wetland project should describe the specific functions to be achieved. Successful attainment of those wetland functions will require consideration of soils, hydrology, vegetation, fish and wildlife, problem plants and animals, recreational use, aesthetic quality, cultural features, social factors, economic considerations, environmental evaluation, and permits and regulations. Refer to EFH, Chapter 13 for additional information on wetland functions.

Consider effects on wetlands and water-related wildlife habitats, including threatened and endangered species. Refer to Section I of the NRCS Field Office Technical Guide for policy and county specific resources.

The work associated with the wetland must not adversely affect other properties, including, but not limited to, surface and subsurface drainage systems. Surface water must not back onto an adjoining property unless the landowner has obtained a flowage easement.

Consider as a high priority those sites adjacent to existing wetlands as they increase wetland system complexity and diversity, decrease habitat fragmentation, and help ensure colonization of the site by wetland flora and fauna.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland complex. By diversifying the types of wetlands within a complex, a wider variety of wildlife species are impacted.

Permits

State and/or local permits may be required for the construction of wetland restorations. A DNR dam safety permit may be required for low head dams if the storage volume is large enough.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications for installing structures for water control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and management plan shall be prepared for each wetland restoration site.

DESIGN TABLES

These tables were developed using a 10 year frequency, 24-hour duration storm event. A runoff curve number (RCN) of 85 was used in the evaluations. The RCN is a composite representation of the entire drainage area, including the wetland. Sites having variables beyond the scope listed in the tables must be flood routed.

Table 2A Designs where DA:PA is less than 10

Drainage Area, Ac	Watershed Slope	Bottom Width, ft	HP ft	Min.Pipe Diam. Required	Pipe HW (feet)
≤40	Up to 5%	15	0.7	None	None
≤40	Up to 5%	10	0.4	10”	0.5
41-60	Up to 5%	25	0.7	None	None
41 - 100	Up to 5%	15	0.6	10"	0.5

Table 2B Designs where DA:PA is greater than 10

Drainage Area, Ac	Watershed Slope	Bottom Width, ft	HP ft	Min Pipe Diam. Required	Pipe HW (feet)
0 - 20	Up to 5%	15	0.7	None	None
20 - 40	Up to 5%	15	1.0	None	None
40 - 60	Up to 5%	30	1.0	10”	0.5
60 - 80	Up to 5%	40	1.0	10"	0.5
≤100	Up to 5%	50	1.0	12"	0.5

Sites with a drainage area exceeding 100 acres must be flood routed. Sites having variables beyond the scope listed in the tables must be flood routed.

If effective skimmers or other trash restricting devices are used, an 8” diameter pipe may be used in place of a 10” diameter pipe when using the designs in Tables 2A and 2B.

Table 2C Red River Valley Designs

Drainage Area, Ac	Watershed Slope	Bottom Width DA:PA ≤ 10	Bottom Width DA:PA > 10	HP ft	Min. Pipe Size Required
≤20	2% or less	10	20	0.5	None
21-40	2% or less	15	50	0.5	None
41-60	2% or less	25	80	0.5	None
61-80	2% or less	30	105	0.5	None
80-100	2% or less	40	125	0.5	None
Up to 150	2% or less	55	165	0.5	None

Table 2C was developed specifically for conditions that occur in the Red River Valley where the precipitation that occurs during a 10 year frequency, 24 hour duration rain event is 3.5 inches or less and the depth of flow in the vegetated spillway will be shallow. If the effective height of the structure will exceed two feet, or the maximum storage exceeds 25 acre-feet, or another parameter in the table is exceeded, a flood routing must be completed to verify the design.

Sites with a drainage area exceeding 150 acres must be flood routed. Sites having variables beyond the scope listed in the tables must be flood routed.

Definitions.

DA:PA – Ratio of acres of drainage area to acres of pool area. The pool area is measured at the run-out elevation.

Drainage Area – Watershed area in acres that contributes water, surface and subsurface, to the wetland basin. This includes the wetland area.

Watershed Slope – Average watershed slope measured not including the wetland area.

Bottom Width – Minimum required bottom width of the vegetated spillway measured in feet.

HP – The calculated flow depth in feet of the design storm through the vegetated emergency spillway.

Pipe HW – The minimum pipe headwater measured in feet from the pipe inlet elevation to the vegetated spillway crest elevation.